hundred and eight pages and forty-one plates, describing the sounding and dredging appliances used by the Blake, and which, for the greater part, were devised or improved during her dredging cruise. So far as her dredging appliances are concerned, the credit for changes made belongs mostly to Mr. Sigsbee and Mr. Agassiz; the former having been in command of the expedition, and the latter in charge of the natural-history operations.

During the seventh decade, European explorers were not idle, and numerous deep-sea expeditions were fitted out. Most notable among these was the cruise of the British ship Challenger around the world between 1873 and 1878. Her scientific results were most interesting; but the older methods of deep-sea work were not greatly altered, although the practicability of using the beam-trawl successfully in the deepest water was fully demonstrated.

In 1881 the French government inaugurated a series of submarine explorations in the Atlantic Ocean and Mediterranean Sea; for that purpose fitting out a small naval vessel, the Travailleur, and placing the management of affairs in the hands of a competent scientific staff, under the directorship of Prof. A. Milne-Edwards. These investigations were continued by the same vessel during 1882, the appliances and methods of work having apparently been patterned after those generally recognized in Europe. In 1883 a larger vessel, the Talisman, was assigned to the work, and operations were established on a much grander scale than before.

For an account of these explorations, descriptive of the methods of work and general results, we are indebted to the last volume of *La Nature*, a French journal of the character of *Science*, which began in a January number the publication of a series of articles by one of the naturalists who accompanied the steamer.[1] Coming from such an authoritative source, we are led to regard these papers almost in the light of a semi-official report, and look to them for at least a correct statement regarding the origin of their methods of work, inasmuch as these matters are discussed in some detail, and with evident pride at the completeness of the outfit. That the outfit was complete, no one who is at all posted on the subject can deny; for nearly all of the many improvements introduced by the coast-survey and fish-commission prior to 1880 are most faithfully copied, and most heartily praised for their perfect adaptation to the requirements of research.

We glance through the several pages of the report for at least some slight acknowledgment on behalf of American inventive skill; but beyond a brief statement to the effect that the hoisting-engine "was of the same type as that employed by Mr. Agassiz," and that he also "used with good results the common form of beam-trawl," we are left to infer that the entire outfit was of French origin; and such must be the impression of every one who reads these papers. In fact, in several instances, credit is explicitly bestowed on French inventors for certain of the appliances which do not differ in any essential features from the corresponding American patterns.

What is to be gained by thus appropriating to the credit of a nation what properly belongs to another and a friendly one, by all the rights of international courtesy, it is difficult to understand, and especially so in this age of supposed enlightenment, when every important discovery is carried with lightning rapidity to all parts of the civilized world. The field of marine research is sufficiently broad to engage the entire attention of all the naturalists who have yet entered it; and the frequent manifestations of jealousy on the part of foreign, and especially French investigators, which often result in wholly ignoring the works of an able American author, can but retard progress instead of aiding it.

Proofs of the superior excellence of American methods of deep-sea research may be found in every important scientific library of Europe as well as this country; and at the two most prominent international fisheries exhibitions of the world, — those of Berlin in 1880, and London in 1883, — all of the American appliances were displayed, and received the highest awards. They have therefore been made sufficiently well known to establish their merits before the scientific world; but, as no descriptions of them have yet been published for the benefit of the general public, we propose in future numbers of *Science* to give accounts of their construction, and of the causes which lead to their introduction.

RICHARD RATHBUN.

[1] For an abstract of the portion relating to the apparatus employed, see *Science*, No. 62.

SPECIAL MANURES FOR PARTICULAR CROPS.

THE fact that the percentages of nitrogen and of the several ash ingredients vary quite widely in different plants (legumes being rich in nitrogen, cere-

als in phosphoric acid, and root-crops in potash) has frequently led to the compounding of so-called special fertilizers or manures, intended to be particularly adapted to the growth of certain crops. The starting-point in the preparation of such fertilizers has usually been Liebig's 'restitution theory' (*ersatzlehre*), according to which the soil must be manured with the same quantities of fertilizing materials as are removed by the crops produced. On this theory, a special manure for beans would contain much nitrogen, and one for corn or wheat much phosphoric acid. Such special manures were first brought prominently into notice in this country by Professor Stockbridge of the Massachusetts agricultural college, and, for the last few years, have enjoyed great popularity, almost every prominent fertilizer-manufacturer producing fertilizers for all conceivable crops, even to orange-trees. These fertilizers have seldom had the same composition in two successive years; and those of each maker have differed from those of every other, thus affording to consumers an abundant variety from which to choose.

It is not proposed here to enter into a consideration of all the numerous fallacies involved in the use of special manures, but only to present the results of some recent experiments, which have an important bearing upon the fundamental idea of such fertilizers. This idea is, in brief, that crops must be manured most abundantly with those elements which they contain most abundantly. There are not wanting, however, indications that this is not altogether true. For example: wheat contains, on the average, about half as much nitrogen as clover; yet experience has shown that wheat is greatly benefited by nitrogenous manures, while clover is comparatively indifferent to them. Indeed, it is a common practice to grow wheat after clover, using the latter crop to gather nitrogen for the former. Many other similar cases might be cited; and it is a noteworthy fact that many special manures, while professing to be compounded on the theory stated above, are, in fact, modified to correspond with these teachings of experience.

All this suggests that one important factor in determining the most suitable manuring for any crop is the power which that crop has of gathering its supplies from natural sources. Paul Wagner has recently published[1] some investigations upon this subject, which are interesting, both in themselves and in their suggestions for future work. He compared peas and barley, growing them in zinc vessels twenty-five centimetres high and twenty-five centimetres in diameter. These vessels were uniformly filled with carefully mixed and sifted soil, were provided with a constant water-supply, and, in short, differed only in the manuring which they received.

The following manurings were given in each series: No. 1, nothing; No. 2, nitrogen; No. 3, potash; No. 4, phosphoric acid; No. 5, phosphoric acid and nitrogen; No. 6, nitrogen and potash; No. 7, potash and phosphoric acid; No. 8, potash, nitrogen, and phosphoric acid. Each manuring was duplicated, so that thirty-two vessels were used in all. Nitrogen was given in every case at the rate of 40 kilos per hectare, in the form of nitrate of soda; potash, at the rate of 80 kilos per hectare, in the form of chloride; phosphoric acid, at the rate of 100 kilos per hectare, in the form of superphosphate. The duplicate manurings gave reasonably accordant results, and the author estimates the limits of error at 3% of the total yield. The following table shows the *relative* yield of total air-dry matter (grain and straw), that of the unmanured vessels being taken as 100.

No.	Manuring.	Crop.	
		Peas.	Barley.
1	Nothing	100	100
2	Nitrogen	104	113
3	Potash	100	107
4	Phosphoric acid	126	113
5	Phosphoric acid and nitrogen	132	146
6	Nitrogen and potash	102	121
7	Potash and phosphoric acid	147	126
8	Potash, phosphoric acid, and nitrogen,	151	181

A study of these figures, remembering that differences of three or four per cent have no significance, leads to the following conclusions: —

The nitrogen had as good as no effect upon the peas (compare 1 with 2, 3 with 6, 4 with 5, and 7 with 8: the greatest difference is 6%). The same comparison for the barley shows that the nitrogen here had a very beneficial effect, the increase in the crop amounting to from 13% (nitrogen alone) to 55% (nitrogen in combination with potash and phosphoric acid). Interesting differences in the effect of potash and of phosphoric acid upon the two plants are also evident, but we pass over these for the present.

The nitrogen of the unmanured soil amounted to 13.77 grams in each vessel; that of the manuring, to 0.2 of a gram. The nitrogen of the unmanured soil was fully sufficient to supply the needs of the peas, as the following considerations show. There were produced —

	Dry matter.	Containing nitrogen.
Without manure	30.0 grams.	0.91 grams.
With nitrogen	31.3 "	0.95 "
With potash and phosphoric acid,	44.0 "	1.34 "
With potash, phosphoric acid, and nitrogen	45.2 "	1.37 "

That is to say, manuring with potash and phosphoric acid enabled the peas to produce 47% more dry matter, the 0.43 of a gram of nitrogen necessary for this increase being obtained as readily from the comparatively insoluble nitrogen of the soil as from the soluble nitrogen added as manure.

For the production of barley, the figures stand as follows: —

[1] *Landw. jahrbücher*, xii. 717.

	Dry matter.	Containing nitrogen.
Without manure	13.5 grams.	0.23 grams.
With nitrogen	15.3 "	0.26 "
With potash and phosphoric acid,	17.0 "	0.29 "
With potash, phosphoric acid, and nitrogen	24.4 "	0.41 "

The nitrogen of the unmanured soil was not sufficient to fully supply the needs of the barley; for while manuring with potash and phosphoric acid only enabled it to produce 26% more dry matter, containing 0.06 of a gram of nitrogen, the addition of 0.2 of a gram of soluble nitrogen enabled it to show an increase of 81% of dry matter, containing 0.18 of a gram of nitrogen.

These facts admit of but one conclusion; viz., that peas are able to assimilate the nitrogen contained in the soil much more readily than is barley. The fact that the pea-plant contains much more nitrogen than the barley-plant does not show that peas should receive much more nitrogenous manure than barley, but, on the contrary, that they can readily supply themselves with nitrogen, but need to be manured with potash, and particularly with phosphoric acid. Barley, on the other hand, contains little nitrogen, partly because it cannot gather it readily, and therefore it needs an artificial supply. In other words, the greater need of nitrogen on the part of the peas corresponds to a greater power of obtaining it.

It is, of course, unsafe to generalize from these two experiments. At the same time, their results correspond so exactly with the teachings of experience regarding the most suitable manuring for legumes and cereals respectively, and appear *a priori* so probable, that one can hardly avoid a strong belief in their general application. They certainly open an interesting and important field for further research. If it can be shown, that, in manuring any given plant, we ought to direct our attention more particularly to those elements of its food which it contains in relatively small quantity rather than to those present in abundance, we shall have made a very considerable advance in our knowledge of the theory of manures.

H. P. ARMSBY.

KOCH'S WORK UPON TUBERCULOSIS, AND THE PRESENT CONDITION OF THE QUESTION.

THE question of the cause of that form of disease known as tuberculosis is one which has been the subject of discussion in medical circles for many years. It is of especial interest to the laity, because in one of its forms it includes the affection so widely known as consumption of the lungs, or phthisis. The idea of a contagious nature as belonging to this process, i.e., to tuberculosis, was first broached in modern times by Villemin,[1] as the result of a series of experiments upon animals, conducted by him. These experiments attracted very great attention at the time, and were subsequently repeated, with varying degrees of success and failure, by numerous observers. Twenty-five years before Villemin's experiments were announced, Klencke [1] claimed to have produced tuberculosis in animals (rabbits) by the inoculation of tuberculous matter. His results do not, however, seem to have received the attention which they deserved; and it is to Villemin that is usually ascribed the beginning of the line of experiment which has resulted in the work which is under consideration to-day.

[1] *Gazette médicale de Paris*, December, 1865. Études sur la tuberculose. Paris, 1868.

Among those who have taken up the question of the specific nature of tuberculosis in inoculation experiments, may be especially mentioned Waldenburg, Klebs, Cohnheim, Fränkel, and Baumgarten. Inhalation experiments, in which the disease is sought to be communicated by forcing animals to inhale finely divided dried tuberculous materials, have been tried again and again with as conflicting results as in the preceding series. Those who have done the most noteworthy work in this direction are Schottelius, Tappeiner, Weigert, Weichselbaum, and Balogh.

Feeding-experiments form the third class by which an endeavor to obtain evidence for or against the specific nature of tuberculosis has been made. It is unnecessary to do more than mention the names of a few of those who have taken a prominent part in this branch of the investigation: such are Aufrecht, Klebs, Bollinger, Colin, Tappeiner, and Toussaint.

These names, forming but a small part of the catalogue of those who have been interested in the study of tuberculosis, will give some indication of the vast amount of work done, and the interest taken in this subject.

After Villemin's experiments, and coincident with all the work that was called out by them, the question of the *nature* of the virus of tuberculosis was eagerly discussed. The idea of a *contagium vivum* was first suggested by Buhl,[2] who claimed to have observed micro-organisms constantly occurring in tuberculous nodules; these micro-organisms being both micrococci and bacteria. This idea was taken up by Klebs,[3] who claimed to have isolated a micrococcus by culture, and to have produced tuberculosis by the inoculation of this organism. Klebs's experiments were repeated, and with the same, or nearly the same, successful results, by Schneller,[4] Reinstadler,[5] and Deutschmann.[6] The acceptance of this monas tuberculosum, as it was called, as the specific cause of the tuberculous process, was not general, however; and for various reasons the work of Klebs seems to be untrustworthy.

[1] Untersuchungen un erfahrungen, etc. Von Professor KLENCKE. Leipzig, 1843. Bd. i.

[2] Lungenentzundung, tuberculose, und schwindsucht, 1873.

[3] *Prager med. wochenschrift*, 1877, Nos. 42 and 43.

[4] *Ueber therapeutische versuche. Arch. für exp. pathol.*, bd. xi., 1879. *Exp. und histolog. untersuchung über die entstehung der tuberculose, etc.*, 1880.

[5] *Arch. für exp. pathol.*, bd. xi., 1879.

[6] *Med. centralblatt*, No. 18, 1881.